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Gender-age distribution of tuberculosis among suspected tuberculosis cases in western Kenya

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Abstract

Globally, tuberculosis (TB) continues to exact an unacceptably high toll of disease and death among children, particularly in the wake of the HIV epidemic. Kenya is ranked 13th among the "22 high-burden TB" countries, and 5th in Africa. To determine the gender-age distribution of tuberculosis among TB suspects in western Kenya. In a cross-sectional study carried out at 10 hospitals in western Kenya, sputa from 872 TB suspects underwent microscopy and culture on solid and liquid media. The growth was identified using the Hain's GenoType® Mycobacterium CM and GenoType® Mycobacterium AS kits. A questionnaire was used to collect demographic data. In total, 41.4% of the TB suspects were diagnosed with mycobacterial disease (95.8% TB cases and 4.2% NTM disease cases). Hence, 39.7% of the suspects were diagnosed with TB, 61.6% males and 38.4% females. A total of 263 (76%) of the 346 TB cases accepted to be tested for HIV infection and 41.8% (110/263) were co-infected (males, 55.5%; females, 44.5%). There was no significant difference in the TB-HIV co-infection rate between genders [OR = 1.006; 95% CI: 0.671-1.508; P = 0.979]. The majority (40.9%) of the TB/HIV cases were in the 25-34-year age bracket. In general, the prevalence of TB was significantly higher in males than females ($\chi 2 = 10.67$; P = 0.001), the majority (37.0%) being in the 25-34 age-group. Children below 15 years constituted 4.9% of the cases. A high prevalence of TB was observed in this study, males in the 25-34 age-group carrying the highest burden. There is need for more efforts and resources to increase knowledge and access TB and NTM syndromes care.

Keywords: Gender-age distribution, TB suspects, western Kenya

Introduction

Tuberculosis (TB) is an ancient disease re-emerging as a global public health crisis [1]. This is despite the availability of effective short-course chemotherapy (DOTS), and the Bacille Calmette-Guérin (BCG) vaccine. The disease continues to claim more lives than any other single infectious agent [2], which is unacceptable, given that most the deaths are preventable [3].

The rate of new TB cases has been falling worldwide for about a decade, achieving the Millennium Development Goals (MDG) global target. However, the rate of decline (2% per year) still remains slow. Of the 22 high TB burden countries (HBCs) (Afghanistan, Bangladesh, Brazil, Cambodia, China, the Democratic Republic of the Congo, Ethiopia, India, Indonesia, Kenya, Mozambique, Myanmar, Nigeria, Pakistan, the Philippines, the Russian Federation, South Africa, Thailand, Uganda, the United Republic of Tanzania, Viet Nam and Zimbabwe) that account for about 80% of the world's TB cases [2,3], seven (Brazil, China, Philippines, Uganda, Viet Nam, India and Tanzania) have met the 2015 targets for reductions in TB incidence, prevalence and mortality [3].

The highest incidence of TB across the globe are in central Africa where death rates exceed 200 per 100 000 a year, and Southern Asia, particularly India, where death rates are between 100 and 200 per 100 000 [4,5]. In Kenya, about 50% of the population have latent TB infection. However, in the last decade the HIV/AIDS epidemic has led to the tripling of the number of new (adult) active TB cases. In 2013 there were about 150, 000 active TB cases in Kenya with an annual incidence of about 89,760 down from 99,159 cases in 2012 [6]. In the current study, the prevalence and gender-age distribution of TB among TB suspects seeking healthcare in western Kenya were determined.

Material and Methods

Study Design

A cross-sectional study was conducted to provide a snapshot (one point in time measurements) description of the gender-age distribution of TB among TB suspects in western Kenya.

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Study setting
The study was done at chest and paediatric clinics at 10 county hospitals in western Kenya. These were Busia, Bungoma, Kisumu, Migori, Kisii, Narok, Kericho, Uasin Gishu and Lodwar district hospitals, and Nakuru Provincial General Hospital. Western Kenya includes the expansive former Rift Valley, Nyanza and Western Provinces, with a cumulative population of about 20 million people, constituting about 52.1% of the Kenyan population.

Sampling frame and patient characteristics
Suspected TB cases were recruited into the study as they sought healthcare services at the chest and paediatric clinics. They had to be resident in western Kenya region for at least six months and consented to participate in the study. Cases that had prior treatment were screened and those already on anti-TB were excluded. Participants were suspected of having TB if they had a cough of more than two weeks not responding to antibiotic treatment7.

Collection of demographic data
A questionnaire was administered to obtain participant demographic data.

Collection of sputum samples
Two sputum specimens (spot, early morning) were collected from participants suspected of having TB under the supervision of trained and competent medical staff. The suspects were requested to cough so that the expectoration came from deep down the chest as possible, and spit into a sterile 50 ml blue cap tubes. For children less than 5 years of age and those less than 10 years of age unable to expectorate sputum had sputum induction performed at the Nakuru provincial and Kisii level 5 hospitals. The samples were refrigerated at 4oC awaiting transportation in cool boxes to the Mycobacteria Reference Laboratory, Moi University School of Medicine (MRL, MUSOM) weekly for analysis. At the MRL, MUSOM, the samples were refrigerated at 4oC till processing. However, most samples were processed within 7 days of collection in order to minimize loss of viability of the mycobacteria.

Consenting participants were voluntarily counselled before they underwent phlebotomy for HIV testing. The blood was delivered into Vacutainer Brand STERILE interior EDTA (K3) tubes and stored at –20oC awaiting processing. The samples were transported in cool boxes to MRL, MUSOM, Eldoret, and screened for HIV infection.

Testing for HIV infection
Whole blood obtained from consenting participants was allowed to clot. Serum was screened used for HIV using Trinity Biotech Uni-GoldTM test and positives confirmed with the enzyme linked immunosorbent assay (ELISA), following manufacturers' instructions. The HIV positive cases diagnosed with TB were considered to TB-HIV co-infected. The HIV positive cases advised to go for post-test counselling and enrolment to HIV/AIDS Programme.

Microscopic examination of specimens
Sputum smears were examined for acid-fast bacilli (AFB) after staining following the Ziehl-Neelsen (ZN) method [8].

Isolation and identification of mycobacteria
Sputum specimens were processed for isolation of mycobacteria following standard protocols [9]. The mycobacterial isolates were identified as M. tuberculosis complex or species of non-tuberculous mycobacteria (NTM) using Hain's GenoType® Mycobacterium CM and GenoType® Mycobacterium AS Molecular Genetic Assays, following manufacturer's instructions [10].

Data analysis
Data was entered in MS Excel 8.0 and analysed using Epi Info version 7 (7.0.9.34). Descriptive statistics were used to summarize data and proportions compared using Chi-square (χ^2) testing. Univariate odds rations (OR) with 95% confidence intervals (CI) were calculated to assess risk factors (gender and age-group) regarding TB infection. Logistic regression was used to analyse multivariate data.

Ethical issues
The proposal for this study was approved by Moi University School of Medicine (MU-SOM) / Moi Teaching and Referral Hospital (MTRH) Institutional Research and Ethics Committee (IREC) [FAN No.00092]. Clearance was also obtained from respective district health authorities and hospital administrations. Informed consent was obtained from candidates or their guardians before they were enrolled into the study. The purpose of the study was explained to the candidates in English, Kiswahili or a local language before consent was sought. Code numbers rather than names were used to identify candidates in order to maintain confidentiality. The study did not expose candidates to any unusual risks as competent hospital staff obtained sputum and blood specimens from candidates using standard procedures.

Results

A total of 872 suspected TB cases were enrolled into the study, 54.9% (477) males and 45.1% (393) females. Their median age was 32 years. The majority of study participants (33.1%) were in the 25-34 age bracket, followed by those in the 35-44 (21.8%) and 15-24 (18.7%) age categories respectively. Paediatric cases (0-14 age bracket) were the lowest with 4.6%, with children 5 years and below accounting for only 0.6% (Table 1 below).

Table 1. Distribution of study participants by gender-age

Age-group	N (%)	Males (%)	Females (%)
0-14	39 (4.5)	22 (2.5)	18 (2.1)
15-24	163 (18.7)	80 (9.2)	83 (9.5)
25-34	288 (33.1)	162 (18.6)	126 (14.4)
35-44	190 (21.8)	108 (12.4)	82 (9.4)
45-54	89 (10.2)	108 (12.4)	36 (4.1)
55-64	54 (6.2)	29 (3.3)	25 (2.9)
> 64	48 (5.5)	25 (2.9)	23 (2.6)
Total	872 (100)	479 (54.9)	393 (45.1)

Sputa from 39.1% (341/872) of the TB suspects were ZN smear positive, of which 53.1% (181/341) were culture positive. Sputa from 3.8% (20/531) of the ZN smear negatives were culture positive. In total, 361/872 (41.4%) of the TB suspects were diagnosed with mycobacterial disease, of which 55.7% (201/361)

were culture positive and 44.3% (160/361) were culture negative. The culture positives yielded 92.5% (186/201) Mycobacterium tuberculosis complex and 7.5% (15/201) non-tuberculous mycobacteria (NTM). The 46.9% (160/341) smear positive but culture negative cases were treated as TB cases. In total, 95.8% (346/361) of mycobacterial disease cases were TB cases and 4.2% (15/361) non-tuberculous mycobacteria (NTM) disease cases. Hence, 39.7% (346/872) of the TB suspects were diagnosed with TB, 61.6% (213/346) males and 38.4% (133/346) females. The prevalence of TB was significantly higher in males than females ($\chi 2 = 10.67$; P = 0.001). The majority, 37.0% (128/346) of the TB cases were in the 25-34 age-group, followed by the 35-44 age-group with 22.3% (77/346). The 15-24 age-group ranked third with 20.2% (70/346), while children below 15 years constituted 4.9 (17/346) of the TB cases (Table 2 below).

A total of 263 (76%) of the 346 TB cases accepted to be tested for HIV infection and 41.8% (110/263) were co-infected. Males constituted 55.5% (61/110) and females 44.5% (49/110). There was no significant difference in the TB-HIV co-infection rate between genders [OR= 1.006; 95% CI: 0.671-1.508; P = 0.979]. The majority (40.9%) of the TB/HIV cases were in the 25-34-year age bracket followed by the 35-44 (24.5%) and 15-24 (19.1%) year age brackets. However, 24% (83/346) of the TB cases declined to be tested for HIV infection (Table 3 below).

Table 2. Tuberculosis prevalence and gender-age distribution

Age-group	Males(%)	Females(%)	Total (%)	OR	95%CI	P-value
0-14	9(2.6)	8(2.3)	17(4.9)	0.84	0.23-3.05	0.79
15-24	41(11.8)	29(8.4)	70(20.2)	2.02	1.07-3.81	0.03
25-34	78(22.5)	50(14.5)	128(37.0)	1.46	0.91-2.35	0.12
35-44	51(14.7)	26(7.5)	77(22.3)	1.99	1.09-3.64	0.02
45-54	21(6.1)	10(2.9)	31(9.0)	1.51	0.60-3.80	0.38
55-64	8(2.3)	5(1.4)	13(3.8)	1.60	0.44-5.74	0.47
> 64	5(1.4)	5(1.4)	10(2.9)	0.94	0.23-3.83	0.94
Total	**213(61.6)**	**133 (38.4)**	**346 100)**	**1.60**	**1.21-2.11**	**0.001**

Table 3. TB-HIV co-infection prevalence and gender-age distribution

Age-group	Males (%)	Females (%)	Total (%)	OR	95%CI	P-value
0-14	4(3.7)	2(1.8)	2(1.8)	0.800	0.098-6.545	0.835
15-24	21(19.1)	13(11.8)	8(7.3)	1.790	0.693-4.622	0.229
25-34	46(41.8)	25(22.7)	21(19.1)	0.820	0.431-1.562	0.547
35-44	27(24.5)	14(12.7)	13(11.8)	0.867	0.380-1.980	0.735
45-54	7(6.4)	4(3.6)	3(2.7)	0.939	0.196-4.496	0.938
55-64	3(2.7)	2(1.8)	1(0.9)	1.760	0.149-0.747	0.653
> 64	2(1.8)	1(0.9)	1(0.9)	0.783	0.046-3.389	0.866
Total	**110(100)**	**61(55.5)**	**49(44.5)**	**1.006**	**0.671-1.508**	**0.979**

Discussion

Kenya observed a sharp decline of TB cases in 2013, having a total number of 89,760, a 9.48% decline from 99,159 cases observed in 2013 [8]. However, TB continues to predominantly affect young adults in their most productive years of life and the 15-44 year age-group continues to bear the highest burden [5,20]. The current study obtained similar results in which the 15-44 age-group constituted 79.5% of the TB cases with males being more affected after the age of 14 years (P = 001). Data from the present study show that the youth bear the greatest TB burden with 39.3% of the cases. These results were in agreement with the KNTLD Unit annual report8, where the 25-34 year age bracket had the highest TB notification. In this age-group, male cases were close to 360 per 100,000 population, and females close to 230 per 100,000 population, giving an average of 295 per 100,000 population [6,12]. These findings agree with a study done in Nairobi by Ndungu et al. (2013) in terms of gender, where 59.7% of the TB cases were males compared to 40.3% females. However, in the latter study the 18-26 age-group had the greatest TB burden [13].

A total of 6,717 new cases of children with TB were reported in Kenya in 2013. This represented 9% of all new TB cases reported during the period. However, in the current study children below 15 years constituted 4.5% of the study population and 43.6% (17/39) of them were diagnosed with TB. This could be under-

estimation for TB diagnosis in children using currently available routine methods [14]. Up to 95% of children aged less than 12 years are often smear-negative and rarely culture positive. Most young children also present with non-cavitating pulmonary TB and are unable to expectorate sputum for microscopy, due to inability to generate enough tussive force. Invasive procedures such as gastric and broncho-alveolar lavage cannot be carried out in most peripheral health facilities in resource- poor countries. Additionally, most published data on the burden of childhood TB do not reflect or capture the occurrence of extra-pulmonary TB (20-30% of the case load in some settings) which occurs much more in children than in adults with TB. Thus, the true incidence of TB disease in children is significantly underestimated [11,15].

Unfortunately, also childhood TB is often accorded low priority by many National TB Control Programmes, due to among others, diagnostic difficulties, misplaced faith in the BCG, childhood TB being rarely infectious, limited resources and lack of data on treatment. However, childhood TB prevalence can be an indicator of community prevalence of sputum smear positive pulmonary TB, age-related prevalence of smear positive TB, prevalence of childhood risk factors for the disease and the stage of the TB epidemic [16]. In Kenya, TB in children below 15 years accounts for more than 10% of all cases notified to the National TB Programme. But since TB detection rate in Kenya is hardly 50% (by microscopy), and TB diagnosis in children is complicated, these cases may be far more than the 10%. This means that at least some other 50% of paediatric TB case are never diagnosed in Kenya and go untreated [17].

There are 1,818 health facilities offering TB microscopy diagnostic services in Kenya, majority of which are government, and a few runs by Mission hospital facilities. More than 55% (1000/1,818) of these facilities are in western Kenya [6]. Sputum smear microscopy is still the main diagnostic method for tuberculosis in the Kenya. A few of the laboratories have graduated to using light emitting diode (LED) Fluorescent microscopes (including all 8-former provincial general hospitals laboratories). However, only five public health facilities offer TB culture services in Kenya [6]. The one at the Moi Teaching and referral Hospital (MTRH) meant to serve western Kenya region has limited capacity, having been recently established. Moreover, it is meant to provide service to re-treatment cases. The Kenya NTLD Unit Annual Reports are based on the data collected at these health facilities most of which lack TB culture services. It is therefore imperative that the national TB statistics may not be very accurate.

It is also evident therefore that in western Kenya, diagnosis and treatment of new TB cases is based on ZN smear microscopy, clinical symptoms, and occasionally augmented with chest X-ray in some health facilities. However, not all acid-fast bacilli represent mycobacteria, let alone M. tuberculosis complex. Not all acid-fast bacilli represent the M. tuberculosis complex. Non-tuberculous mycobacteria [18] and some other bacterial species including Nocardia species which are widespread19 yield positive results in ZN smear detection of acid-fast bacilli (AFB). For instance, in the present study, 4.2% (15/361) of the mycobacterial disease cases were NTM cases. Similarly, a significant proportion of patients, especially HIV positives, may give negative ZN smear results although they are culture positive [20]. In the current study for instance, 160 cases were ZN smear positive but culture negative, and were treated as TB. It is possible some of them could have NTM or other acid-fast non-mycobacterial diseases misdiagnosed as TB.

The results of the present study indicate that TB-HIV co-infection is still pervasive in Kenya as the rest of sub-Saharan Africa, and presents special challenges. Infection with TB enhances HIV replication and does accelerate the progression of HIV infection to AIDS. Tuberculosis accounts for over one-third of HIV/AIDS deaths worldwide and is a major cause of morbidity among people living with HIV/AIDS (PLWHA). On the other hand, HIV is the single most important factor contributing to increasing incidence of TB in last two decades, particularly in sub-Saharan Africa where up to 70% of TB cases are HIV positive. In Kenya, HIV has significantly influenced the increased proportion of smear negative TB since 2005, which has contributed to TB morbidity and mortality. The HIV is also thought to have significantly contributed to the TB cases requiring re-treatment [21]. The emergence and rapid spread of X/MDR-TB reportedly more prevalent among TB-HIV cases presents a tremendous challenge and threatens to reverse the progress so far made in the control of both TB and HIV/AIDS [22].

Conclusions

In conclusion, a high prevalence of TB was observed among TB suspects at chest and paediatric clinics in western Kenya, with males in the 25-34 age-group carrying the highest burden. A high TB-HIV co-infection rate (41.8%) was observed in western Kenya albeit slightly lower than the national average of 45%. The study also indicates the need for clinicians to be empowered with knowledge on how to treat NTM syndromes, since treatment for TB and NTM syndromes are not directly analogous.

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Competing interests

The authors declare that they have no competing interest.

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References

1. Catwell MF, Sinder DE, Cauthen GM, Onorato IM. Epidemiology of tuberculosis in the United States, 1985 through 1992. JAMA. 1994;272(7):535-9.

2. Snider DEJ, Raviglione M, Kochi A. In Tuberculosis: Pathogenesis, Protection, and Control. edition. Bloom BR. Washington DC: Am Soc Microbiol. 1994;2-11.

3. World Health Organization. Global tuberculosis report. WHO/HTM/TB/2013.11. Geneva, Switzerland, 2013.

4. World Health Organization. Global tuberculosis control, WHO/HTM/TB/2008.393. Geneva, Switzerland, 2008.

5. World Health Organization. Global tuberculosis control - epidemiology, strategy, financing. WHO Report. WHO/HTM/TB/2009.411. Geneva, Switzerland, 2009.

6. Ministry of Health: Kenya NTLD Unit Annual Report 2013. http://www.nltp.co.ke/docs/Kenya_TB_Annual_Report_2013.pdf access date 2013

7. Ministry of Health, Government of Kenya. Guidelines for Management of Tuberculosis and Leprosy in Kenya, July 2013 Edition.

8. Ebersole LL. Acid-fast stain procedures. In: Isenberg HD, ed. Clinical Micribiology Procedure Handbook. Washington, DC: ASM Press; 1992:3.5.1-3.5.10.

9. BD BBL MGIT Package inserts 2012.

10. Hain lifescience, GmbH, Nehren, German, Package inserts 2012.

11. Johnson JL, Ellner JJ. Tuberculosis and Atypical Mycobacterial Infections. In: Tropical Infectious Diseases: Principles, Pathogens & Practice, Vol. 1. Guerrrant RL, Walker DH, Weller PF. eds. Churchill Livingstone, Philadelphia. 1999;443-73.

12. Division of Leprosy, Tuberculosis and Lung Disease. Ministry of Public Health and Sanitation, Government of Kenya. Annual Report, 2007.

13. Ndungu PW, Revathi G, KariukiS, Ng'ang'a Z. Risk factors for the transmission of tuberculosis in Narobi: A descriptive epidemiological study. Advances in Microbiology. 2013;3:160-5.

14. Marais BJ, Gie RP, Hesseling AC, et al. Radiographic signs and symptoms in children treated for tuberculosis: possible implications for symptom-based screening in resource-limited settings. Pediatr Infect Dis J. 2006;25:237-40.

15. Hatherill M, Hanslo M, Hawkridge T, et al. Structured approaches for the screening and diagnosis of childhood tuberculosis in a high prevalence region of South Africa. Bull World Health Organ. 2010;88(4):312-20

16. World Health Organization. Treatment of tuberculosis. Guidelines for National Programmes. 2003. WHO/CDS/TB 2003:313). Geneva.

17. National leprosy and tuberculosis programme (NLTP), Ministry of Health, Republic of Kenya. Annual Report, 2006.

18. Buijtels PC, van-der-Sande MA, de-Graaff CS, et al. Nontuberculous mycobacteria, zambia. Emerg Infect Dis. 2009;15(2):242-9.

19. Olson ES, Simpson AJ, Norton AJ, et al. Not everything acid fast is Mycobacterium tuberculosis: a case report. J Clin Pathol. 1998;51(7):535-6.

20. American Thoracic Society. An Official ATS/IDSA Statement: diagnosis, treatment, and prevention of non-tuberculous mycobacterial diseases. 2007.

21. Division of Leprosy, Tuberculosis and Lung Disease. Ministry of public health and sanitation, Government of Kenya. Annual Report, 2009.

22. World Health Organization. Global tuberculosis control - epidemiology, strategy, financing. WHO Report. WHO/HTM/TB/2007.376. Geneva, Switzerland, 2007.

23. Li R. Forensic biology. 2nd edition. CRC Press. New York. 2015;3-4.